

1     WHAT IS CLAIMED IS:

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3     1.     A method of producing a (run, level) encoded picture from an original picture,  
4     said method comprising:

5                 producing respective sets of transform coefficients for blocks of pixels in the  
6     original picture;

7                 quantizing transform coefficients in the respective sets of transform coefficients to  
8     produce respective sets of quantization indices for the blocks of pixels, wherein  
9     quantization indices for at least some of the blocks are produced by using a quantization  
10    step size that is not uniform within said at least some of the blocks;

11                 selecting largest magnitude quantization indices from the respective sets of  
12     quantization indices to produce respective sets of quantization indices having non-zero  
13    levels for the blocks of pixels; and

14                 (run, level) encoding quantization indices from the respective sets of quantization  
15    indices to produce the (run, level) encoded picture.

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17     2.     The method as claimed in claim 1, wherein the respective sets of transform  
18     coefficients for the blocks of pixels are produced by computing discrete cosine  
19    transforms.

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21     3.     The method as claimed in claim 1, wherein the largest magnitude quantization  
22     indices are selected from the respective sets of quantization indices by finding up to a  
23     selected number of largest magnitude non-zero quantization indices from each of the  
24     respective sets of quantization indices.

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2     4.     The method as claimed in claim 1, wherein the largest magnitude quantization  
3     indices are selected from the respective sets of quantization indices by sorting up to a  
4     selected number of non-zero quantization indices from each of the respective sets of  
5     quantization indices.

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7     5.     The method as claimed in claim 1, wherein the original picture is a frame of  
8     motion picture video, the respective sets of transform coefficients for the blocks of pixels  
9     are produced and quantized by an MPEG encoder to produce (run, level) coded MPEG  
10    video, and the largest magnitude quantization indices are selected from the respective sets  
11    of quantization indices during transcoding of the (run, level) coded MPEG video to  
12    produce reduced-bandwidth, reduced-quality MPEG encoded video.

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14    6.     The method as claimed in claim 1, wherein the (run, level) encoding of the  
15    quantization indices from the respective sets of quantization indices to produce the (run,  
16    level) encoded picture includes (run, level) encoding of quantization indices that are not  
17    the largest magnitude quantization indices in order to (run, level) encode the largest  
18    magnitude quantization indices with fewer bits than would otherwise be required for (run,  
19    level) encoding of the largest magnitude quantization indices.

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21    7.     A method of scaling non-scalable MPEG-2 coded video to produce reduced-  
22    bandwidth, reduced-quality MPEG-2 coded video, the non-scalable MPEG-2 coded video  
23    including a set of non-zero AC discrete cosine transform (DCT) coefficients for 8x8

1 blocks of the non-scalable MPEG-2 coded video, said method comprising removing non-  
2 zero AC DCT coefficients from the non-scalable MPEG-2 coded video so that the  
3 reduced-quality MPEG-2 coded video includes no more than a selected number of largest  
4 magnitude quantization indices for the non-zero AC DCT coefficients for each 8x8 block.

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6 8. The method as claimed in claim 7, which includes, for each of the 8 x 8 blocks of  
7 the non-scalable MPEG-2 video:

8       a.) parsing and copying a differential DC coefficient variable-length code (VLC);  
9       b.) parsing and decoding (run, level) event variable-length codes (VLCs) up to an  
10 end-of-block marker to identify a respective set of non-zero quantization indices;  
11       c.) finding up to the selected number of non-zero quantization indices having the  
12 largest level magnitudes in the respective set of non-zero quantization indices to identify  
13 a respective set of largest magnitude non-zero quantization indices; and  
14       d.) applying (run, level) event formation and entropy encoding to the set of largest  
15 magnitude non-zero quantization indices.

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17 9. The method as claimed in claim 8, which includes sorting indices in the respective  
18 set of non-zero quantization indices in order to find up to the selected number of non-zero  
19 quantization indices having the largest level magnitudes in the respective set of non-zero  
20 quantization indices.

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22 10. The method as claimed in claim 8, wherein the application of (run, level) event  
23 formation and entropy encoding to the set of largest magnitude non-zero quantization

1 indices includes (run, level) encoding of quantization indices that are not largest  
2 magnitude quantization indices in order to (run, level) encode the set of largest magnitude  
3 quantization indices with few bits than would otherwise be required for (run, level)  
4 encoding of the set of largest magnitude quantization indices.

5

6 11. A digital computer programmed for producing a (run, level) encoded picture from  
7 an original picture, wherein the digital computer comprises at least one processor  
8 programmed for:

9 producing respective sets of transform coefficients for blocks of pixels in the  
10 original picture;

11 quantizing transform coefficients in the respective sets of transform coefficients to  
12 produce respective sets of quantization indices for the blocks of pixels, wherein  
13 quantization indices for at least some of the blocks are produced by using a quantization  
14 step size that is not uniform within said at least some of the blocks;

15 selecting largest magnitude quantization indices from the respective sets of  
16 quantization indices to produce respective sets of quantization indices having non-zero  
17 levels for the blocks of pixels; and

18 (run, level) encoding quantization indices from the respective sets of quantization  
19 indices to produce the (run, level) encoded picture.

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21 12. The digital computer as claimed in claim 11, wherein the processor is  
22 programmed for producing the respective sets of transform coefficients for the blocks of  
23 pixels by computing discrete cosine transforms.

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2       13. The digital computer as claimed in claim 11, wherein the processor is  
3       programmed for selecting the largest magnitude quantization indices from the respective  
4       sets of quantization indices by finding up to a selected number of largest magnitude non-  
5       zero quantization indices from each of the respective sets of quantization indices.

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7       14. The digital computer as claimed in claim 11, wherein the processor is  
8       programmed for selecting the largest magnitude quantization indices from the respective  
9       sets of quantization indices by sorting up to a selected number of non-zero quantization  
10      indices from each of the respective sets of quantization indices.

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12       15. The digital computer as claimed in claim 11, wherein the original picture is a  
13       frame of motion picture video, the processor is programmed for producing and quantizing  
14       the respective sets of transform coefficients for the blocks of pixels during MPEG  
15       encoding of the original picture to produce (run, level) coded MPEG video, and the  
16       processor is programmed for selecting the largest magnitude quantization indices from  
17       the respective sets of quantization indices during transcoding of the (run, level) coded  
18       MPEG video to produce reduced-bandwidth, reduced-quality MPEG encoded video.

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20       16. The digital computer as claimed in claim 11, wherein the processor is  
21       programmed for (run, level) encoding of the quantization indices from the respective sets  
22       of quantization indices to produce the (run, level) encoded picture by including (run,  
23       level) encoding of quantization indices that are not the largest magnitude quantization

1 indices in order to (run, level) encode the largest magnitude quantization indices with  
2 fewer bits than would otherwise be required for (run, level) encoding of the largest  
3 magnitude quantization indices.

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5 17. A digital computer for scaling non-scalable MPEG-2 coded video to produce  
6 reduced-bandwidth, reduced-quality MPEG-2 coded video, the non-scalable MPEG-2  
7 coded video including a set of non-zero AC discrete cosine transform (DCT) coefficients  
8 for 8x8 blocks of the non-scalable MPEG-2 coded video, the digital computer comprising  
9 a processor programmed for removing non-zero AC DCT coefficients from the non-  
10 scalable MPEG-2 coded video so that the reduced-quality MPEG-2 coded video includes  
11 no more than a selected number of largest magnitude quantization indices for the non-  
12 zero AC DCT coefficients for each 8x8 block.

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14 18. The digital computer as claimed in claim 17, wherein the processor is  
15 programmed for processing each of the 8 x 8 blocks of the non-scalable MPEG-2 video  
16 by:

- 17 a.) parsing and copying a differential DC coefficient variable-length code (VLC);  
18 b.) parsing and decoding (run, level) event variable-length codes (VLCs) up to an  
19 end-of-block marker to identify a respective set of non-zero quantization indices;  
20 c.) finding up to the selected number of non-zero quantization indices having the  
21 largest level magnitudes in the respective set of non-zero quantization indices to identify  
22 a respective set of largest magnitude non-zero quantization indices; and

1           d.) applying (run, level) event formation and entropy encoding to the set of largest  
2       magnitude non-zero quantization indices.

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4       19. The digital computer as claimed in claim 18, wherein the processor is  
5       programmed for sorting indices in the respective set of non-zero quantization indices in  
6       order to find up to the selected number of non-zero quantization indices having the  
7       largest level magnitudes in the respective set of non-zero quantization indices.

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9       20. The digital computer as claimed in claim 18, wherein the processor is  
10      programmed for applying (run, level) event formation and entropy encoding to the set of  
11      largest magnitude non-zero quantization indices by including (run, level) encoding of  
12      quantization indices that are not largest magnitude quantization indices in order to (run,  
13      level) encode the set of largest magnitude quantization indices with fewer bits than would  
14      otherwise be required for (run, level) encoding of the set of largest magnitude  
15      quantization indices.

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